

Supporting Material

Plastic work to heat conversion during high-strain rate deformation of Mg and Mg alloy

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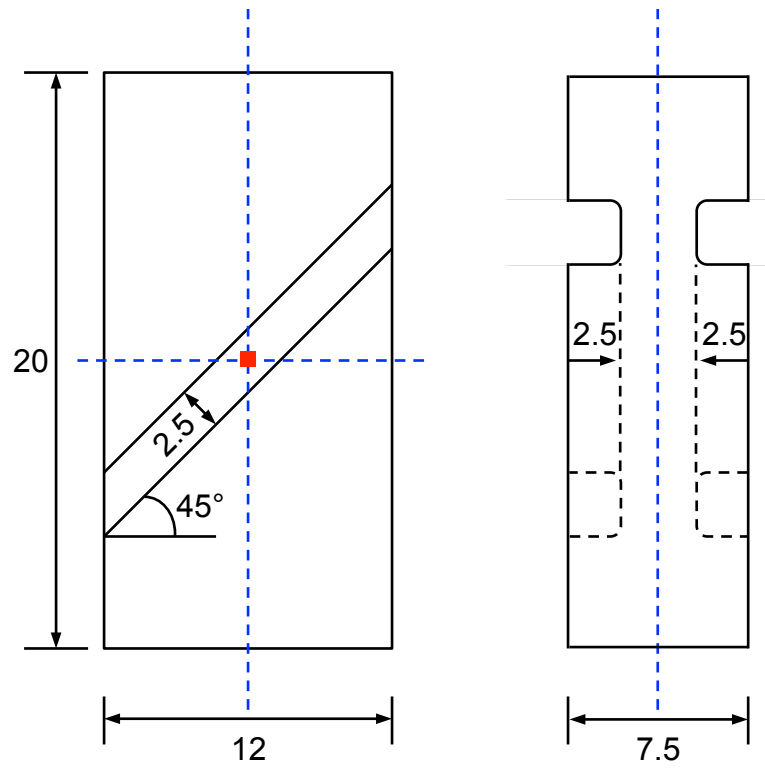


Figure S1: Schematic representation of the shear compression specimen (not to scale). The red square represents an approximate location from where temperature rise during dynamic deformation was measured. All dimensions are in millimeters [1].

Calibration of the IR detector system

The IR detector set up contains a single element and liquid N₂ cooled HgCdTe detector, and a matching amplifier. The size of the active area of the detector is about 100 μm \times 100 μm and thus temperature is also measured from a very small area of the sample (100 μm \times 100 μm) [2].

Figure S1 shows an approximate location within the thin gage section from where temperature rise during dynamic deformation was measured. The temperature measurement is an average within the bulk material. The optical imaging system (Newtonian) comprises a concave mirror with a radius of curvature of 140 mm and a 45° reflecting mirror placed at the focus of the concave mirror. The area magnification was set to approximately 1. Data acquisition rate used was 20 MHz. Since the IR detector produces signals in voltage, calibration curves are necessary to convert voltage signals to temperatures. For this purpose, a small K-type thermocouple was tightly inserted at mid thickness of the gauge section of a dummy SCS. Calibration procedure consisted of heating the sample using a IR heater, then placing the sample between incident and transmission bars, and recording the signals both from the thermocouples and IR detector as the sample cooled down to room temperature. Thin ceramic disks were placed between the sample and bar interfaces to cut down the heat loss from the sample to the bars. In the current experiments, calibration curves were produced multiple times to insure repeatability. Considerable care was taken for repeatable sample positioning between the bars and accurate focusing of the IR system on the gauge section. It is known that roughness developed on the sample surfaces during mechanical deformation can affect the emissivity of the samples and, therefore, calibrations were conducted on pre-deformed specimens.

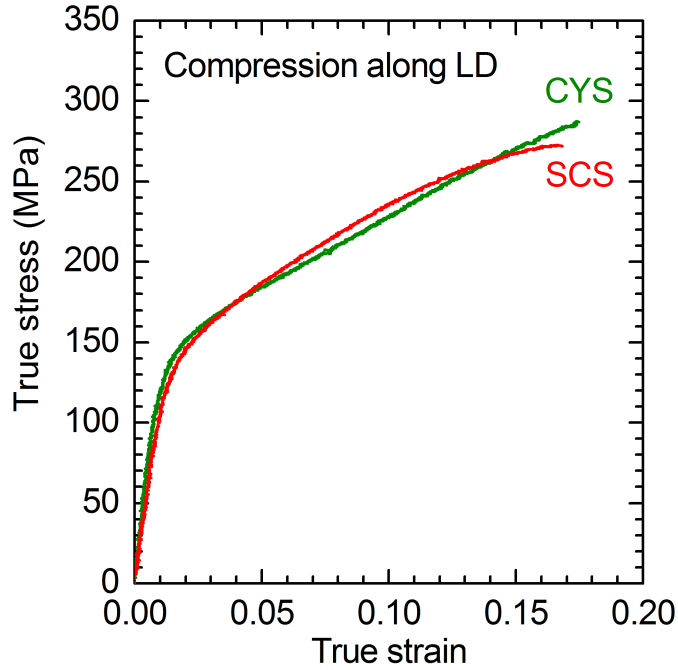


Figure S2: A comparison of the quasi-static stress-strain responses measured from the CYS and SCS geometries. By fitting the quasi-static compression load-displacements data from the SCS to that from the CYS, empirical constants (k_1 , k_2 and k_3) in equations (1-3) were obtained to derive the stress, strain and strain data for the SCS geometry.

References

- [1] D. Rittel, G. Ravichandran, A. Venkert, Mater. Sci. Eng. A 432 (2006) 191.
- [2] D. Rittel, M. L. Silva, B. Poon, G. Ravichandran, Mech. Mater. 41 (2009) 1323.